DOCUMENT RESUME

ED 024 232 EF 002 204

Planning for Shops and Laboratories.
North Carolina State Board of Education, Raleigh. Div. of School Planning.
Pub Date [67]
Note- 13p.
EDRS Price MF-$0.25 HC-$0.75
Descriptors- Building Design, *Educational Parks, Electricity, *Environmental Influences, Industrial Arts, *Laboratories, Plumbing, *School Shops

General guidelines for educators and architects in planning for industrial education, shops, and laboratory facilities necessary to the instructional program, are provided. Characteristics of the environment discussed are as follows--(1) spatial, (2) thermal, (3) visual, (4) sonic, and (5) aesthetic. Utility services covered are electrical power, plumbing, compressed air and gas, and waste disposal. A selected bibliography is included. (JS)

ED 24032

Planning for SHOPS AND LABORATORIES

EF 02204

Division of School Planning, Department of Public Instruction, Raleigh, North Carolina

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

PLANNING

FOR SHOPS AND LABORATORIES

Division of School Planning
State Department of Public Instruction
Raleigh, North Carolina

PREFACE

The purpose of this publication is to provide general guidelines for educators and architects in planning for industrial education, shops, and laboratory facilities necessary to the instructional program. The information is not intended to provide specifications for any one kind of facility but to offer basic suggestions pertinent to the planning of any school laboratory to meet the needs of the future.

In addition, this publication should challenge the planners of future shops, laboratories, and other facilities to design them capable of responding to changes and new situations. The future facilities should do more than merely echo the conventional shop or laboratory of the past. A modern facility should be planned and designed to encourage interrelationships of classroom experiences within the comprehensive program.

This bulletin has been prepared by Ben D. Quinn, Educational Consultant, Division of School Planning, with the assistance of a committee composed of the following: C. H. Fries, Jr., Superintendent of Nash County Schools; Robert A. Mullen, Associate Director, Division of Vocational Education; J. D. Morgan, Assistant Superintendent of Charlotte-Mecklenburg Schools; E. P. Pearce, Jr., Superintendent of Guilford County Schools; and Maylon McDonald, Associate Superintendent of Fayetteville City Schools.

J. L. Pierce, Director
Division of School Planning

CONTENTS

	Page
Introduction	1
Definitions	2
Locations	3
Characteristics	3
Spatial	4
Thermal	5
Visual	6
Sonic	7
Aesthetic	7
Utility Services	7
Electric Power	7
Plumbing	8
Compressed Air and Gas	8
Waste Disposal	8
Features	8
Bibliography	9

PLANNING FOR SHOPS AND LABORATORIES

Introduction

Today, as never before, changes are rapidly taking place in the manufacturing of goods for the market and, consequently, the skills needed by the students who plan to enter the world of work. These changes are demanding changing technology. One responsibility of society, and more specifically the school system, is to provide educational facilities (shops and laboratories) as a part of a comprehensive school to meet the growing needs and demands for new training. Not only is it important to supply trained technical students for a demanding society, but it is the responsibility of each school system to provide a truly comprehensive curriculum to meet the needs of all students attending schools.

Within the comprehensive school, industrial education shops are needed for the purpose of providing an area (space) in the facility that will be conducive, and not restrictive, to the learning process in both general and vocational education. The term "general education" is used to indicate that part of a student's whole education which looks first to his life as a responsible human being and citizen; whereas, the term "vocational education" indicates that part of education that develops competence in some occupation. These two sides of life are not entirely separable, and it would be false to imagine education for the one as quite different from the other. In order to discharge one's duties adequately as a citizen in a modern democratic society, a person must somehow be able to grasp the complexities of life as a whole.

It follows, therefore, that a student should be prepared in general education to enjoy and appreciate living and in vocational education to develop a competence in some occupation. Thus, the two types of education must be given together, and the facilities constructed to house these programs should encourage unity of purpose rather than a separate approach.

Definitions

Industrial Education--A generic term used to designate various types of education of an industrial nature--vocational industrial education, industrial arts, technical education, and apprenticeship training in both public and private schools.

Shop--A term used rather commonly and somewhat loosely to refer to study or instruction in wood or metalwork or other industrial laboratory skills and procedures; used also to refer to the laboratory and equipment used.

Vocational Shop--A shop designed and equipped to be used for instruction in some vocation.

Industrial Arts Shop--A room equipped with tools and machinery for learning practical arts, such as woodwork and metalwork.

Laboratory--A room or rooms appropriately equipped and used by students for the study of some branch of science or the application of scientific principles.

Although the word "shop" receives almost universal usage, the Division of School Planning prefers to describe spaces for vocational and industrial arts education as laboratories and will hereafter use the term "laboratory" in this publication.

Categories of Laboratories

Laboratories, as referred to in this publication, are classified in three major categories: (1) light, (2) medium, and (3) heavy.

TABLE I--SPACE RECOMMENDATIONS

	Category	Laboratory	Square Feet Per Pupil
I.	Light (for example, Drafting, Health Occupations, Commercial Sewing, or Vocational Office Education)	Desirable Average Minimum	75 60 50
II.	Medium (for example, Electricity, Graphic Arts, or Cosmetology*)	Desirable Average Minimum	120 90 75
III.	Heavy (for example, Auto Mechanics, Carpentry, Agriculture, Industrial Arts, or Machine Laboratories)	Desirable Average Minimum	150 120 100

*State Board of Cosmetic Arts (size of facility requires 3000 square feet minimum).

Locations

Relationship of Laboratories to Remainder of School Plant--If proper sound control measures are used, and this is advocated, the noisiest producing laboratory could better be located to encourage the interrelationship of classroom experiences previously described in this publication. If, however, acoustical measures are not taken, most of the heavy and some of the medium laboratories should be either in a separate wing or housed independently if the school's campus is composed of several buildings.

Relationship of Laboratories to One Another--The relative location of laboratories in accordance with the nature of their basic activities is highly important; and when two or more closely related laboratories (for example, carpentry, cabinetmaking, industrial arts or construction industry laboratories) are part of a school's program, it is desirable that they be adjacent to one another. Most heavy and medium laboratories should be located on the ground floor.

Characteristics

More definite information concerning area and facility characteristics is given in the following five categories:

1. Spatial--Table I may be used as a guide and should be used only as a basis for checking the reasonableness of space allotments. No laboratory can arbitrarily be classed as light, medium, or heavy without knowledge of class content or character of the equipment.

   Size--The size of the laboratory will depend upon the purpose and enrollment of the school. Where feasible, the space should be large enough to house all related activities; that is, all building trades--electricity, carpentry, masonry, etc.

   Shape--The laboratory should be rectangular or square and designed without columns or structural protuberances if economically feasible. Each basic area within the laboratory should have movable partitions to separate but not to isolate; that is, carpentry from masonry, etc.

   Ceiling Heights--The necessity for overhead cranes and hoists should be taken into consideration. Generally, 12 feet minimum clearance is needed for a heavy laboratory and less for the lighter laboratories. Most light and medium laboratories will not require more ceiling height than a regular classroom.

   Access--Student access doors should be convenient and comply with all fire and safety codes. Most heavy laboratories require at least one overhead service door approximately 10 feet high and 12 feet wide. Although some of the medium and light laboratories will not require the overhead service door, installation of such a feature may be desired.

   Toilet Rooms--Toilets should be easily accessible, well lighted, well ventilated, and within the laboratory complex wherever possible.

   Storage Rooms--Special areas need to be provided for (1) student projects, (2) instructional supplies, (3) materials, (4) tools and (5) special storage rooms for precision instruments.

   Lockers--Each student should have a locker for individual storage of personal belongings and incompleted laboratory projects. In an industrial laboratory, consideration might be given to dressing rooms and shower space.

   Surfaced Apron--An outside, paved, covered apron should be provided for most heavy and some medium laboratories for outdoor instruction, storage of equipment, and for more convenient access.

   Greenhouse--A greenhouse is necessary for programs that study plant science and related subjects. The size and

type will depend upon the expected student enrollment and the type of programs.

Floors--The flexibility of a school's program from year to year makes it imperative to anticipate use and equipment that may cause problems which affect floor loads. These factors should be given consideration in the design of the building. Factors to be considered in choosing materials for laboratory floors include: (1) installation cost, (2) acoustics, (3) reflectance, (4) resilience, (5) ability to withstand acids and solvents, and (6) maintenance.

Dustproof Finishing Rooms--In laboratories where finishing rooms are required, special attention should be given to assure that the finishing rooms are properly equipped with special lighting, exhaust fans, and special electrical switches to comply with all existing codes.

2. Thermal--Laboratory areas should be provided with complete thermal control; if economically feasible, year-round air-conditioning should be provided. Rather than pointing to obvious laboratory needs in thermal control, specific emphasis should be given to heating and ventilating problems.

Heating:

- The laboratories might be used for night school programs and, therefore, should have heat controls separate from the rest of the building.

- In automotive repair and similar laboratories where pupils frequently work on the floor, special attention should be given to assure sufficient heat on the floors or possibly in the floors.

- Special attention should be given to the type heating radiation which is selected for laboratory classrooms so that it has a minimum noise level.

Ventilating:

- The general problem of ventilating laboratories is comparable to ventilating other areas in a school. In addition, special problems occur in various laboratories and special equipment will be needed to exhaust noxious odors, dust, fumes, and gases.

- Proper ventilation can best be provided by installing a positive means of fresh air intake. Dependence upon windows and doors to provide intake air is not satisfactory. Fresh air should be introduced through controlled openings installed for that purpose.

- Mechanical ventilation should provide a <u>minimum</u> of ten (10) cubic feet of fresh air per minute per pupil. If effective ventilation for comfort and cooling is desired, then 20-30 cfm per pupil should be provided. Variable speed fans should be used to allow easy control of ventilation rates.

- Fan noise level is always important and should be taken into consideration. However, a higher noise level is more acceptable in heavy laboratories than the light and medium laboratories and instructional areas.

- Specific areas which may require special consideration include welding booths and tables, paint spray booths, grinding equipment in machine laboratories, and dust and shavings in cabinetmaking and millwork. In laboratories where internal combustion engines are run, special ventilation for removing carbon monoxide gas needs to be provided.

3. Visual--Natural light is recommended and should be obtained through the use of windows with an acceptable method of control. The windows should be high enough above the floor to allow work stations to be placed along the wall. It is suggested that window sills in heavy laboratories be at least 48 inches high. The height of some medium and most light laboratory window sills should be approximately desk level. The following table gives the type of facilities and the recommended number of footcandles needed for good artificial illumination.

TABLE II--ILLUMINATION

LOCATION	MINIMUM MAINTAINED FOOTCANDLES OF GENERAL ILLUMINATION
Laboratories	100
Classrooms	70
Chalk Boards	150
Sewing Rooms	150
Drafting Rooms	100*
Locker Rooms and Toilets	30
Storage Rooms	15-20

*Cartography, designing, and detailed drafting should have 200 footcandles. The general illumination needs to be supplemented by specific lighting.

4. Sonic--Acoustical environmental control presents two major problems, which with proper planning could be eliminated: (1) noise on the inside of the laboratory that beclouds intelligibility and (2) the machine noise originating inside the laboratory that disturbs the learning process in other areas of the school.

5. Aesthetic--Beauty is found in a laboratory as in any building when a balance has been achieved between good, attractive, adequate, and economical space; safety environment; sonic environment; thermal environment; and visual environment. These five factors must also be blended in their interrelationships.

Utility Services

Electric Power--The anticipated use of the laboratories will determine the amount of electrical service needed. In general, heavy and medium laboratories will require more electrical service than light laboratories. It is recommended that 100% of the total connected load be provided in all laboratories to allow for changes in future programs. Also:

- Care should be taken to provide sufficient wall outlets at workbench height.

- The special nature of welding outlets should be carefully considered as to capacities, location, and number.

- There are two generally acceptable methods of providing power to machinery: (1) overhead busways and (2) underfloor or in-the-floor ducts spaced parallel at convenient intervals. The latter has more flexibility and is recommended. The major disadvantage of the overhead busways is that an electrical conductor or cord will always be hanging down; however, the overhead busways are being used extensively.

- Where practical, three-phase electrical service (as opposed to single-phase) should be used as an economy measure.

- A control should be provided to allow all service power, except lighting, to be cut off at one point. It is also advisable to have panic buttons located in strategic areas which would shut off all power except to the light fixtures.

- Secondary voltage should be either 120/208 or 120/240. The widely used 120/208 voltage is preferable. Safety factors suggest that higher secondary voltage, such as 277/480, should never be used in laboratories.

Plumbing--

- Wash Sinks and Drinking Fountains: Hot and cold water need to be available in a wash sink. Where water is to be used as an instructional material, an analysis should be made as to the estimated volume needed. A drinking fountain should be located near the wash sink but not as a combination fixture.

- Toilet Rooms: Toilets should be easily accessible, well lighted, well ventilated, and within the laboratory complex wherever possible.

- Floor Drains: Floor drains should be installed in appropriate laboratories.

Compressed Air and Gas--Compressed air and gas should be accessible to most heavy laboratories and are needed in some light and medium laboratory programs. Since compressed air and gas may not be needed in all laboratories, it is suggested that air and gas lines be provided in appropriate places and appropriate sizes if use is anticipated and tapped and used as needed.

Waste Disposal--The problem of waste disposal should be given consideration. The kind and amount of waste created will depend upon the type and size of the laboratory. If air-conditioning is to be installed in woodworking or similar dust producing laboratories due to the problems inherent in pulling undue amounts of dirt into the air-conditioning system, a complete dust control system is recommended.

Features

Large Group Instructional Room--Classroom space, separate and apart from the laboratory, is needed for most heavy laboratory programs. Some of the light laboratories do not require a full-time large group instructional area. In larger schools, this can be accomplished by providing a classroom which would be available for several laboratory programs; whereas in smaller schools, an adjacent classroom could be shared with other departments.

Display Areas--An area should be provided for displaying student work in or near the entrance of the laboratory.

Audiovisual Aids Area--An audiovisual aids area is recommended within the laboratory layout and is not intended to replace the need for a large group instruction room or audiovisual room.

BIBLIOGRAPHY

1. Bureau of Educational Research and Development, Basic Planning Guide for Vocational and Technical Education Facilities. U. S. Office of Education Special Publication No. 11. Washington, D. C.: Government Printing Office, 1965.

2. Campbell, Edward A., "Flooring--A Vital Environmental Element," The American School Board Journal. December, 1965, pp. 13, 14.

3. Delta Power Tool Division, Rockwell Manufacturing Company, School Shops for Today and Tomorrow. Pittsburgh 8, Pennsylvania, U. S. A., 1960.

4. Division of School Planning, Minimum Check List for Mechanical Plans and Specifications. Raleigh, North Carolina, State Department of Public Instruction, 1965, Revised.

5. National Council on Schoolhouse Construction, Guide for Planning School Plants. Washington, NCSC, 1964.

6. Rockwell Manufacturing Company, School Shop Development Research and Planning. Pittsburgh, Pennsylvania, The Rockwell Building, 1966.

7. Sarchett, A. M., "Maximum Mileage from School Shops," The American School Board Journal. April, 1965, p. 52.

8. State Department of Public Instruction, A Guide for Planning Buildings, Facilities, and Equipment for Vocational Education Agriculture. Raleigh, North Carolina, June, 1962.

9. University of the State of New York Education Department, A Planning Guide for Vocational-Industrial and Technical Building Facilities. Albany, New York, University of the State of New York Press, 1954.